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ABSTRACT

The hypothesis that the Scholastic Aptitude Test (SAT) score decline is a result of changing American family sizes and configurations is explored. This possible explanation of declining SAT scores had been offered by Robert B. Zajonc in an article discussing the relation between family configuration and cognitive development. Since a number of investigations have shown that "earlyborn" students--those who were the first or second child in their families--and members of small families tend to have higher scores on tests such as the SAT, a change in the representation of students who are earlyborn and members of small families in the population could possibly cause a decline in the average for the total population. The confluence model hypothesis is explored through a consideration of the magnitude of the change in family configurations over the years of interest, and the magnitude of observed score difference for the SAT. It is concluded that, while the Zajonc hypothesis seems sound, it could only account for a small portion of the total SAT score decline. (Author/EVH)

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Family Configuration Effects and the Decline in College Admissions Test Scores: A Review of the Zajonc Hypothesis

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In three recent publications, Zajonc (1975a, 1975b, 1976) has argued that the mean test score declines in college applicants observed over the past several years are due, in part, to changes in family configurations in the national population. He has predicted that the mean scores will reach a perigee toward the end of the 1970s and then begin to increase sharply in the early 1980s. The purposes of this paper are to review the Zajonc theory, examine its foundations, and attempt to estimate what magnitude of score decline might be a result of family configuration factors.

The Confluence Model

Zajonc and Markus (1975) formulated what they term the confluence model of intellectual development. In this model, the family environment is seen as a causal influence determining much of the intellectual ambience of individual experiences. The mathematical formulations of the model predict higher intelligence, generally, for those of smaller families with substantial age spacing between siblings. At another extreme, twins are predicted to be of lower intelligence on the average. (There exists much research evidence to support lower average intelligence for twins.) The confluence model was offered as an explanation of the research findings of Belmont and Marolla (1973) who demonstrated some rather striking effects of birth order and family size on the mean scores of Raven Progressive Matrices (a nonverbal intelligence test). Although the Belmont and Marolla data were from the Netherlands, other large-sample studies have yielded similar results in other countries. Breland (1974) reported remarkably similar patterns of scores on the National Merit Scholarship Qualification Test (NMSQT) in the United States. Record, McKeown, and Edwards (1969) reported almost the same kinds of results in a study of verbal reasoning abilities of eleven-year-old English children. There have been many other studies of the effects of birth order and family size on cognitive abilities, but few with the consistency in findings of these three. Many of the studies have concluded that there are no such effects, and some have observed effects in the opposite direction (i.e., that firstborn are the least intelligent and that members of the larger families are the most intelligent). Schooler (1972) wrote a comprehensive review strongly suggesting that the study of such phenomena was fruitless and should be discontinued.

The confluence model of Zajonc and Markus takes its name from a hypothesized similarity between social processes and fluid flow processes. That is, the social process of the family is seen as resembling the flow of a river in which separate currents make up the river. The currents affect the river, and the river affects the currents. In a similar fashion, the growing individual is influenced by the family environment, and the individual in turn influences the family environment. The process is a dynamic one in which mutually dependent changes in the individual and in the environment occur simultaneously. The confluence model can be applied when a reliable measure is available of the individual quality under examination. Intelligence is one quality for which reliable measures are available. The child entering the world, as a

stream enters a river, is confronted by a large number of factors that will have bearing upon his or her intellectual growth. As life progresses, these factors change and the child changes.

In applying the confluence model to the Belmont and Marolla data, Zajonc and Markus limit the environmental factors operating to those represented in the data, viz., birth order and family size. Although the effects of spacing of children can be entered in the model, the Belmont and Marolla data did not include spacing, and accordingly spacing effects could not be checked with the data. There are also other important variables such as the intelligence of parents, parent's absence from the family, and the intelligence of siblings that were not included in the application of the confluence model to the data. Nevertheless, Zajonc and Markus suggest that complex relationships among birth order, family size, and intelligence can be predicted using the confluence model. For example, a firstborn in a family of three would be predicted by the model to achieve a slightly higher level of intelligence than a firstborn who is an only child. This kind of outcome can be predicted because the mathematical relationships used in the confluence model include a consideration of the intellectual value of the teaching role of the firstborn with younger siblings in contrast with the lack of a teaching role for the only child.

Family Configuration and Test Score Decline

With respect to the declines in admissions test scores of college applicants during recent years, the family configuration effects take on importance because of the unusual family configuration patterns emerging as a result of World War II and the considerable change in these patterns that occurred during the years following World War II. Large numbers of new families were started during and immediately following the war, and as a result there were disproportionate numbers of firstborn children in some years. In 1940 over 38 percent of all children born were firstborn, in 1941 over 40 percent were firstborn, and in 1942 almost 43 percent were firstborn. There was a slight reduction in firstborn between 1943 and 1946, but in 1947 the proportion of firstborn again approached 43 percent. By 1950 the proportion of firstborn had decreased to 32 percent, and in 1955 it was less than 29 percent. This decline in the proportion of firstborn children continued until 1962 at which point it began to increase again.

If one assumes that the modal age of persons taking the SAT is 17 years, the peak years of SAT scores (1960-64) can be hypothesized as being related to the peak years of firstborn births (1943-47). And the decline in scores from 1964 to 1976 is concomitant with the decline in firstborn births to 1959. Since the decline in the proportion of firstborn births ceased in 1962, one might predict that the SAT score decline will also cease in 1979. Zajonc has arrived at a similar prediction using mean birth rank instead of proportions of firstborn, since under the confluence model all members of the family play a part in intellectual development. A useful way of thinking about the possible relationship between changing family patterns and the score decline is to imagine the family configurations of persons taking admissions tests in 1963,

the year in which the mean scores peaked, in contrast to the probable family configurations of persons taking tests in 1976. In 1963 an unusually high proportion of test takers were probably firstborn because the age group, nationally, was high in proportion of firstborn.¹ Moreover, a high proportion were probably secondborn as well, and second-born represent another high-scoring group in the post-World War II birth population. In 1947, 71 percent of all births were either firstborn or secondborn, whereas in 1959 only 53 percent of births were of these two types.

Most of the Zajonc work is based upon studies of populations outside the United States and of one population in the United States, the National Merit population of 1965. It is reasonable to ask whether family configuration effects have been observed in SAT populations. Altus, in 1965 and in a number of other papers, reported results of a series of studies conducted at the University of California at Santa Barbara. Table 1 shows the results obtained when students entering in the 1960-61 academic year were studied with respect to the configurations of their families. For both males and females, and in all three family sizes studied, firstborn performed consistently better on the SAT-verbal test. While the same consistency is not evident in the SAT-mathematical means, there is a similar trend in some family sizes.

Table 1. SAT Means by Family Configuration for Students Entering the University of California (Santa Barbara), 1960-1961^a

Sex	Family size	Birth order	N	Mean SAT-V score	Mean SAT-M score
Male	2	1	174	537.50	560.50
		2	77	527.50	568.75
	3	1	111	532.25	574.00
		2	66	531.50	552.75
		3	30	500.50	553.75
	4	1	32	553.75	539.50
		2	26	511.00	563.00
		3&4	16	547.25	581.75
Female	2	1	328	530.25	492.75
		2	180	510.00	494.50
	3	1	183	526.00	491.75
		2	99	522.50	488.50
		3	56	509.75	485.25
	4	1	70	553.75	511.25
		2	30	516.25	488.75
		3&4	24	488.00	480.75

a. From Altus (1965).

Similar findings were obtained by Lemay (1969) in a study of students entering Oregon State University in the 1963-64 academic year. Lemay's results, shown in Table 2, are more consistent than were those of Altus, and the SAT-mathematical means are seen to follow a step-down progression as do the SAT-verbal means. Although no table is available, Walker and Tahmisian (1967) reported observations at Westmont College like those by Altus and Lemay.

Table 2. SAT Means by Family Configuration for Students Entering Oregon State University 1963-64^a

Family size	Birth order	N	Mean SAT-V score	Mean SAT-M score
2	1	156	477.45	474.56
	2	145	467.49	463.53
3	1	107	461.75	466.11
	2	103	445.48	452.74
	3	86	450.13	450.65
4	1	50	485.70	473.02
	2	63	452.03	472.58
	3&4	48	442.31	434.23

a. From Lemay (1969).

Estimating the Magnitude of Family Effects

At the extremes, the data of Altus would suggest differences due to family configuration effects of around 40 points on the SAT-verbal scale. Lemay's data show an extreme difference of about the same magnitude on both verbal and mathematical tests. On the surface, therefore, it would appear that the family configuration theory that Zajonc has put forth for the score decline is plausible and could account for practically all the declines that have been observed in the SAT population. Such a conclusion, however, would require that all students taking the SAT in 1963 were the firstborn of two-child families and that all students taking the SAT in 1976 were thirdborn or fourthborn of four-child families (considering the Lemay data of Table 2, for example). In addition, it would be necessary that effects such as those observed by Altus and Lemay in the early 1960s persisted from that time until 1976. And there exists no evidence to confirm that family configuration differences of this type did persist beyond the early 1960s.

To arrive at some kind of rough estimate of the magnitude of possible effects of the type hypothesized by Zajonc, it is useful to assume that the effects persisted over a long period of time. Then one only needs to know something of the changes that have occurred in family sizes and mothering patterns over the period of interest. Evidence of changes in families can be obtained from natality tables of United States vital

statistics such as those reproduced in Table 3, which shows birth rates from 1946 to 1967 subclassified by the order of live births. To illustrate, in 1947, there were 47.8 firstborn white births per 1,000 white women between the ages of 15 and 44. In 1960, the birth rate for first-born was only 30.8. Changes in the birth rates for other birth orders (and family sizes, implicitly) are also shown in Table 3. By comparing the natality data with estimated family configuration effects on SAT scores, assuming that effects observed in only a few years persisted over a long time, it is possible to arrive at an estimate of the magnitude of the possible family configuration effects.

Table 3. U.S. White Birth Rates^a by Order of Birth and Year from 1946 to 1967^b

Year	Total Birth Rate	Birth Rate by Birth Order						
		1	2	3	4	5	6&7	8+
1946	100.4	39.5	28.5	14.4	7.3	4.0	3.9	2.8
1947	111.8	47.8	30.8	15.3	7.4	4.0	3.8	2.7
1948	104.3	39.9	31.1	15.7	7.4	3.9	3.7	2.6
1949	103.6	36.3	32.2	16.6	7.9	4.0	3.8	2.7
1950	102.3	33.3	32.3	17.9	8.4	4.1	3.7	2.5
1951	107.7	35.0	32.9	19.5	9.4	4.5	3.9	2.5
1952	110.1	34.1	33.1	21.0	10.4	5.0	4.0	2.5
1953	111.0	33.3	32.9	21.6	11.1	5.4	4.3	2.5
1954	113.6	33.3	32.8	22.6	12.0	5.9	4.6	2.5
1955	113.8	32.6	32.0	22.9	12.6	6.2	4.9	2.5
1956	116.0	33.2	31.9	23.4	13.1	6.6	5.2	2.6
1957	117.7	33.4	31.7	23.7	13.7	7.0	5.6	2.7
1958	114.9	31.9	30.6	23.1	13.8	7.2	5.7	2.7
1959	114.6	31.3	30.0	23.0	14.1	7.4	6.0	2.8
1960	113.2	30.8	29.2	22.7	14.1	7.5	6.1	2.8
1961	112.2	30.7	28.3	22.2	14.0	7.7	6.4	2.9
1962	107.5	29.8	26.9	20.9	13.3	7.5	6.2	2.9
1963	103.7	29.4	25.9	19.6	12.6	7.1	6.1	2.9
1964	99.9	29.8	24.8	18.5	11.7	6.7	5.7	2.7
1965	91.4	28.9	23.0	16.2	10.2	5.8	5.0	2.4
1966	86.4	30.1	22.0	14.4	8.7	4.9	4.3	2.1
1967	83.1	29.7	22.1	13.5	7.9	4.3	3.7	1.8

a. Birth rate is defined as the number of live births per 1,000 white women aged 15-44 years.

b. From Vital Statistics of the United States. Volume 1, Natality. Tables 1-8.

In Table 4, data summarized by Zajonc (1976) are used to make estimates of possible contributions to the SAT score decline of family configuration factors.² First, an estimate is made of the incremental value of being of a particular birth order in terms of standard deviations. These estimates are based on four different studies reported

Table 4. Estimate of Magnitude of Family Effects on the SAT Score Decline

Birth order	Estimated intellectual difference (S.D.s) ^a	Estimated SAT-V difference ^b	Proportion in population ^c		Estimated population change	Estimated contribution to SAT decline
			1964 (1947) ^d	1976 (1959) ^d		
1	+.15	+16.5	.427	.273	-.154	-2.54
2	+.10	+11.0	.275	.262	-.013	- .14
3	-.10	-11.0	.137	.201	+.064	- .70
4	-.20	-22.0	.066	.123	+.057	-1.25
5	-.30	-33.0	.036	.064	+.028	- .92
6&7	-.40	-44.0	.034	.052	+.018	- .79
8+	-.50	-55.0	.024	.024	+.000	- .00
						-6.34

a. Estimated from Figure 1 of Zajonc (1976).

b. Assuming an SAT-V standard deviation of 110.

c. Computed from Table 3.

d. Years in parentheses are the birth years of 17-year-olds.

by Zajonc. Next, assuming an SAT-V standard deviation of 110, it is possible to estimate birth order and family size differences in terms of the SAT scale. These SAT scale differences are then multiplied by changes in the population proportions to determine an estimated contribution of each part of the population change to the SAT score decline. The population proportions shown in Table 4 for 1964 and 1976 were estimated from Table 3 as the ratio of birth rate within birth order to total birth rate. The possible contributions to SAT declines shown in the last column of Table 4 were computed as the difference in population proportions for the two years of interest multiplied by the incremental advantage or disadvantage. Thus, the major portion of the possible decline contribution comes from a decrease in the proportion of firstborn in the population. The total effect on the SAT score decline is estimated at about 6 SAT scale points.³

Conclusions

A careful consideration of the hypothesis advanced by Zajonc for part of the SAT score decline has revealed two important results. First, the hypothesis suggests that changing population factors may indeed have been one cause of the SAT score decline. Second, despite the strength of the suggestion, the magnitude of such effects may not be large. Under the assumption that the differences in observed scores categorized by family configuration are due to the environment of the family (Zajonc's theory), the magnitude of the effects is probably not large at all. It is important, however, to emphasize that the possible impact of changing family structures does not depend upon the validity of the confluence model. Regardless of whether the family environment is the cause of the observed differences in mean test scores for different family configurations, the fact remains that such differences have been observed and that the population, nationally, has been changing in its relative proportions of persons with the various family configurations.

Another way of viewing the data that Zajonc has used in developing his theory is that the differences observed are only a manifestation of some other more important factor. The research term used usually in this context is that of a possible intervening variable. It may be that while observed differences in test scores are small when comparing categories of family configurations, they would be large if the intervening variable were known and observable. An analogy from Stephens (1968) is useful here. Sex of an automobile driver may be shown to be related to number of accidents, since men have more accidents than women. An important intervening variable in this analogy is number of miles driven, however. Miles driven is associated with number of accidents to a greater degree than is sex. But if miles driven were not known, one would still observe a relationship between sex and number of accidents. It is possible that family configuration and SAT scores are related through some similar unknown intervening variable, and this intervening variable may explain a larger portion of the score decline.

Nonetheless, without some evidence to indicate that there may be an intervening variable of importance, it seems reasonable to conclude that the Zajonc hypothesis could account for only a small portion of the total

SAT score decline. Since the effects observed could have occurred whether or not the confluence model of environmental causation is valid, it seems unnecessary to explore that question.

FOOTNOTES

1. However, many studies have shown that those who attend college are overrepresented by firstborn and other earlyborn.
2. Assuming that distributions by family configuration categories are the same in SAT-taking populations as in national populations. While it is known that such an assumption is not absolutely valid, the differences in the SAT-taking and national distributions may not be large.
3. Schrader (1976) has estimated the effect of the Zajonc hypothesis on the SAT score decline at around 4 or 5 SAT scale points.

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